# On the relation between economic integration and the pattern of public spending

Stéphane Riou, Nelly Exbrayat, Carl Gaigne

# On the relation between economic integration and the pattern of public spending

Nelly Exbrayat
(Creuset, University of Saint-Etienne)

Carl Gaigné
(INRA Rennes)

Stéphane Riou *
(Creuset, University of Saint-Etienne)

October 2005

**Abstract**

We analyze the efficiency of the pattern of public spending when two asymmetric economies are not perfectly integrated and their private sectors are imperfectly competitive. We show that tax harmonization constrains the low productivity country to set higher subsidies for firms. Moreover, while households located in the low productivity country seem to be the net-contributors of their public sector regardless the level of trade costs, residents of the more advanced country may shift from a position of net-contributors to net-recipient when trade costs are low enough. Finally, we isolate two main externalities suggesting that a coordinated policy increasing the public spendings for households in both countries will be beneficial. Thus, with a very different framework, our results seem to confirm the robustness of the main conclusion of Keen and Marchand (1997): governments could spend too much for firms and the inefficiency arising from competition for multinationals concerns both the level of taxation and the resulting pattern of public spending.

*Corresponding author. e-mail: stephane.riou@univ-st-etienne.fr. address: stephane riou, creuset, 6 rue basse des rives 42023 Saint-Etienne, cedex 02.

# 1 Introduction

Countries may affect business location decisions in essentially two ways: by implementing an attractive tax policy, and by developing a favourable economic environment. Many models show that trade integration and the increasing mobility of capital likely intensify the tax competition to attract firms implying too low levels of public expenditures (for a survey see Wildasin and Wilson, 2003). However little attention has been given to the impact of economic integration on the pattern of public spending despite the obvious policy relevance of the subject. Indeed, on the one hand, because tax competition could be harmful, tax coordination is now high on the political agenda of the OECD countries (and especially in UE). This could make the subsidies competition for firms more vigorous. On the other hand, the location of multinational firms seems to be driven by spatial differences in public inputs or subsidies (Bénassy-Quéré, Gobalraja and Trannoy, 2005; Head, Ries and Swenson, 1999)[1]. Consequently, there is a risk that more economic integration combined with more tax coordination modify the destination of public expenditures in favour of firms and to the detriment of households which are less geographically mobile[2].

A recent theoretical literature deals with the impact of competition between jurisdictions on the composition of public spending. From a traditional model of tax competition without trade, Keen and Marchand (1997) argue that fiscal competition may indeed lead to systematic distortions of the pattern of public spending. Governments spend too much in public input for firms compared to public good for workers. This result may not hold when residents are mobile because a shift of public good provision devoted to workers in favour to firms may induce a labor outflow (Matsumoto, 2000). A similar result is obtained by Borck (2004) by distinguishing mobile and immobile workers. However, these models consider that the location of capital is only driven by public policies (through taxation and the expen-

[1] Several cases in which US and European governments have paid large location subsidies are well known. After a strong competition between several european countries, the Korean company Daewoo was deciding to locate a production plant in France in 1994. The amount of direct subsidies is estimated at 30 Millions Euros added to 2 Millions euros of tax exemptions on corporate tax rates.

[2] Notice also empirical evidences reveal a correlation between trade integration and pattern of public spending. For example, from a sample of 23 OECD countries, Rodrik (1998) shows a positive relationship between trade openness and public expenditure varying with respect to the type of government spending. More recently, Sanz and Velazquez (2004) find a $\sigma$-convergence concerning the structure of government expenditures among the OECD member states.

ditures). One need to consider as well incentives to location coming from the private market forces whose strength is shaped by economic integration. We know that firms producing under imperfect competition have a strong incentive to agglomerate when trade costs become low enough in order to exploit scale economies (Krugman, 1991, Ottaviano, Tabuchi and Thisse, 2002, Combes and Overman, 2005). Such mechanisms modify strategic tax policies. The government of the country where firms are concentrated can tax the 'agglomeration rent' that firms enjoy without inducing relocation, as shown Ludema and Wooton (1998), Kind et al. (1998) and Ottaviano and Van Ypersele (2005) from different models of economic geography.

The main purpose of the present paper is to analyse of the role played by trade integration in the destination of public spending. We also determine whether the coordination of public subsidies for firms is necessary. To explore these questions, we elaborate an economic geography framework à la Ottaviano, Tabuchi and Thisse (2002). Two countries compete to attract multinationals in an environment of imperfect competition with barriers to trade. Our model is close to Ottaviano and van Ypersele (2005) since we consider asymmetric competition between governments to attract firms (a country benefits to an comparative advantage) and two tax instruments (a tax on the workers' wage and a tax on firms' profit). However, unlike Ottaviano and van Ypersele (2004), we consider that tax revenues can be shared between an individual subsidy to mobile firms and an other one to immobile households. Since we focus on the pattern of public spending and its relation with trade integration, tax rates are exogenous.

Our main results can be summarized as follows. First, the country enjoying a productivity advantage set lower net-of-tax subsidy for each firm than the other country. Nevertheless, both subsidies describe an identical bell-shaped relationship with trade liberalisation. Secondly, we show that the most generous country in terms of subsidy per firm is not necessary the country with the highest budget devoted to the economic activity located in its area. Provided that both trade costs and corporate tax rates are high, the high-productivity country can spend more for firms and households than the low-productivity country. Moreover, we show that households located in the low productivity country are the net-contributors of the public policy regardless the level of trade cost, while advanced stage of trade integration may twist the position of households located in the high productivity country from a role of net-contributor to a role of net-recipient. Finally, we wonder if the pattern of public spending is efficient from a social optimum point of view. We identify two types of externalities, one passing through the consumers' surplus, the second arising from the net benefit of the pub-

lic spending for immobile households. While both externalities may act in opposite directions depending on the level of trade integration, we find that the aggregate welfare would be improved by a coordinated reduction in the provision of subsidies to firms.

The rest of the paper is organised as follows. The model is developed in the next section. In section 3, we display the location equilibrium for given public policies. Then, in section 4, we determine the level of susbsidies for firms in each country arising from Nash competition among benevolent governments. Section 5 proposes a welfare analysis and section 6 concludes.

## 2 A simple model of location and trade

We consider an economy made of two countries, labelled $r = 1, 2$. There are two sectors, a private sector and a public sector. The private sector consists of a modern industry ($M$) and a traditional one ($T$). The M-sector produces a continuum of varieties of a horizontally differentiated product under increasing returns, using workers as the only input. The T-sector produces a homogenous good (the numéraire) under constant returns, using also workers as the only input. Firms of the M-sector are multinational owned by outside shareholders and perfectly mobile between regions. We focus on multinational firms since there are clear evidences that this category of firms largely benefits from subsidy policies (see, for instance Bénassy-Quéré, Gobalraja and Trannoy, 2005; Head, Ries and Swenson, 1999). Indeed, various benefits are waiting from the attraction of multinational firms: jobs, productivity spillovers, market access spillovers (eg. Blomström and Kokko, 1998). Workers are not mobile between regions but are mobile between private sectors and their spatial distribution is uniform ($L_1 = L_2 = L$ ). Countries only differ in productivity in the modern industry. The public sector consists of two governments providing a subsidy to mobile firms ($f_r$) and a subsidy to immobile households ($h_r$). While the subsidy to immobile households can be viewed as social spendings, the public policy for firms may include the most direct instruments by which a country reduced the cost of doing business within its boundaries. Among the most frequent incentives, we can cite various forms of tax exemptions, grants, land acquisitions for firms or the development of enterprise zones which have effects on the location choice but do not directly affect labour and capital productivity[3].

[3] Observe that countrary to our assumption, most of the papers on the pattern of public spendings assume public inputs that complement particular private factors of production (see. Matsumoto, 2004, Keen and Marchand, 1997).

## 2.1 Consumption

Preferences are identical across workers and, following Ottaviano et al. (2002), are captured by a quasi-linear quadratic utility given by:

$$u(.) = \alpha \int_0^n q(i)\, di - \frac{\beta - \delta}{2} \int_0^n [q(i)]^2\, di - \frac{\delta}{2} \left[ \int_0^n q(i)\, di \right]^2 + q_O \qquad (1)$$

where $\alpha > 0$ and $\beta > \delta > 0$. In this expression, $\alpha$ measures the intensity of preferences for the differentiated product with respect to the numéraire. The condition $\beta > \delta$ implies that workers have a preference for variety. Finally, $q(i)$ is the quantity of variety $i \in [0, n]$ and $q_O$ the quantity of the numéraire. Each worker is endowed with $\overline{q}_O > 0$ units of the numéraire. The initial endowment is supposed to be large enough for her/his consumption of the numéraire to be strictly positive at the market outcome. Her/his budget constraint can then be written as follows:

$$\int_0^n p(i)\, q(i)\, di + q_O = \overline{q}_O + y_r \qquad (2)$$

where $p(i)$ is the consumer price of variety $i$ and $y_r$ is the workers's net income residing in country $r$ with

$$y_r \equiv w_r + h_r - \rho_r$$

with $w_r$ the wage tax prevailing in country $r$, $h_r$ is the amount of the subsidy for each inhabitants living in country $r$ and $\rho_r$ means the unit tax rate on wages. Given the assumption of symmetry between varieties, solving the consumption problem yields the demand functions for a representative variety located in $r$ from region $r$ ($q_{rr}$) and region $s$ with $s \neq r$ ($q_{rs}$):

$$q_{rr} = a - (b + cn)\, p_{rr} + cP_r \quad q_{rs} = a - (b + cn)\, p_{rs} + cP_s \qquad (3)$$

where

$$a \equiv \alpha / [\beta + (n-1)\,\delta] \quad b \equiv 1 / [\beta + (n-1)\,\delta] \quad c \equiv \delta / (\beta - \delta)\,[\beta + (n-1)\,\delta]$$

and $p_{rr}$ (resp., $p_{rs}$) is the price of a variety located in region $r$ to consumers of region $r$ (resp., $s$). Finally,

$$P_r = n_r p_{rr} + n_s p_{sr} \quad P_s = n_r p_{rs} + n_s p_{ss} \qquad (4)$$

are the price indices (i.e., $n$ times the average price) of varieties in region $r$ and in region $s$, respectively, with $n_r$ and $n_s$ the number of varieties/firms located in $r$ and $s$.

## 2.2 Private sector

There are two private sectors. The traditional sector produces a homogeneous good under perfect competition and constant returns to scale. One unit of output requires one unit of labor. The T-good is costlessly traded between regions so that its price is the same everywhere. This makes that good the natural choice for the numéraire, which implies that price of the T-good ($p^T$) and, the equilibrium wage of immobile workers ($w^T$) are equal to one everywhere. The T-sector is not taxed since equilibrium profits are zero.

The modern sector supplies varieties under increasing returns to scale and monopolistic competition. There exists a one-to-one correspondence between firms and varieties. Firms of M-sector compete within a large group of firms. The total mass of firms in this sector is fixed and is equal to $n$.[4] We consider a market structure with monopolistic competition in which entry is restricted instead of being free. Thus, firms have a market power and will earn positive profits which will be taxed by governments. For a firm located in country $r$, the production of any variety requires a fixed amount $\phi_r$ of labor $L$ with

$$\phi_2 > \phi_1$$

In other words, we assume that country 1 has an advantage in terms of productivity.

Varieties of M-good are traded at a cost of $\tau$ units of the numéraire per unit shipped between the two countries. As firms bear trade costs, profits of a representative firm in region $r$ are as follows:

$$\pi_r = p_{rr} q_{rr} L_r + (p_{rs} - \tau) q_{rs} L_s - \phi_r - t_r + f_r \quad \text{with } r \neq s \tag{5}$$

where $L_r$ (resp., $L_s$) is the number of workers located in country $r$ (resp., $s$), $t_r$ is the unit tax in region $r$ and $f_r$ is the subisidy for each firm established in country $r$. Note that because labour is mobile between sectors, the wage rate is fixed to 1 in the M-sector. Nevertheless, this will be verified only if the sector $T$ is always active in both regions. Then, we have to ensure that a single location alone cannot supply the world demand in the homogeneous good. The condition is $1 < 2q_O$.[5].

[4] Picard et al. (2004) have the same assumption in a spatial version of Dixit-Stiglitz model.

[5] An other condition indicates that full agglomeration of the modern sector in one region is not sufficient to promote equilibrium in the labor market of this region, that is $L > 2\phi_r N$ where $\phi_r N$ is the number of workers employed in the modern sector when a core-periphery configuration emerges.

When producers maximise profits, they take the price indices as given. Nevertheless, the market as a whole has a non negligible impact on each firm's choice in that each firm must account for the distribution of all firms' prices through an aggregate statistics (the price index) in order to find its equilibrium price. Thus, the market solution is given by a Nash equilibrium with a continuum of players in which prices are interdependent. We assume that markets are internationally segmented so that each firm chooses a delivered price which is specific to the country in which its variety is sold. The profit-maximizing prices are the same obtained by Ottaviano et al. (2002) and are given by

$$p_{rr} = \frac{1}{2}\frac{2a + \tau c(n - n_r)}{cn + 2b} \quad p_{rs} = p_{ss} + \frac{\tau}{2} \tag{6}$$

Freight absorption by firms located for instance in country $r$ is a decreasing function of their relative number. The reason is that as $n_r$ falls, the market in region $s$ becomes more crowded pushing down local prices. As a result, the elasticity of demand for firms located in $r$ rises on foreign sales while falling on domestic ones. The result is that they find convenient to reduce their operating margins on foreign sales while increasing them on domestic sales (Brander and Krugman, 1983).

By inspection, it is readily verified that $p_{rr}$ is increasing in $\tau$ because the local firms are more protected against foreign competition. By contrast, $p_{rs} - \tau$ is decreasing because it is now more difficult for firms to sell on the foreign market. As firms' prices net of trade costs are to be positive for any distribution of workers, we assume throughout this paper that

$$\tau < \tau_{trade} \equiv \frac{2a}{2b + cn}. \tag{7}$$

This condition also guarantees that it is always profitable for a firm to export to the other region.

### 2.3 Public sector

We consider that each country maximises the aggregated welfare of workers/consumers living in its jurisdiction given by

$$W_r = S_r L + (1 + h_r - \rho_r)L \tag{8}$$

with $S_r$ is the consumer's surplus in country $r$ given by

$$S_r = \frac{a^2 n}{2b} - a(n_r p_{rr} + n_s p_{sr}) + \frac{b + cn}{2}(n_r p_{rr}^2 + n_s p_{sr}^2) - \frac{c}{2}(n_r p_{rr} + n_s p_{sr})^2$$

where prices are given by (6). An increasing number of firms located in country $r$ raises the surplus of workers living in this country since the price of local varieties decreases and less varieties are imported. Unlike Keen and Marchand (1997) there is no indirect effects of the public spending to firms on the level of the capital rent which would be internalized by the government. A major argument is that ownership of plant of multinational corporations is usually geographically widespread. Thus it will have a very marginal impact on the residents' welfare that governments can neglect. Observe that this assumption is supported by Keen and Marchand (1997) who consider that it would also be beneficial to assume a case of foreign direct investments when analysing the pattern of public spending. For them, it would mitigate the tendency towards relative over-provision of public spendings to firms.

Public funds have two possible allocations: an individual subsidy for firms ($f_r$) or for immobile residents ($h_r$) so that

$$G_r = h_r L_r + f_r \lambda_r n \tag{9}$$

where $G_r$ is the level of public expenditures in country $r$ and $\lambda_r = n_r/n$ is the share of firms located in country $r$ with $\lambda_r + \lambda_s = 1$. To finance these public spendings, two tax instruments are used : a unit tax rate on profits ($t_r$) and a unit tax rate on wages ($\rho_r$). Therefore, in each country, tax revenues are expressed as follows:

$$T_r = t_r \lambda_r n + \rho_r L \tag{10}$$

Given the budget constraint, $G_r = T_r$, using (10) and (9) leads to the following equality:

$$(h_r - \rho_r) L_r = (t_r - f_r) \lambda_r n. \tag{11}$$

This means that, when the grants net of profit tax rate are positive in country $r$ ($t_r - f_r < 0$), workers living in this country are the net contributors in the redistribution system ($h_r - \rho_r < 0$) and vice-versa.

Because we focus on the composition of public spending and not on the level of public expenditures, we assume that the level of tax rates in each country is exogenous (because of tax coordination, for example). However, tax revenue in each country remains endogenous since it depends on the spatial distribution of tax base.

### 2.4 Sequence of events

There are two types of actors in our model: firms and governments. In the first stage, each government chooses simultaneously its individual subsidy

for firms $f_r$ taking as given the decision of the other local government, and anticipating the private sector outcomes and the resulting location equilibrium. In stage 2, given the preferences announced by the governments, firms choose their place of production. All players have a perfect information and the game is solved by a sub-game perfect equilibrium involving backward induction beginning with the last stage.

# 3 Location equilibrium

The location of firms is governed by the spatial differences in net profits,

$$\pi_r = \Pi_r - \phi_r - t_r + f_r \tag{12}$$

where $\Pi_r$ is the equilibrium gross profits earned by a firm established in $r$ on the market of the region $r$ and $s$ with

$$\Pi_r \equiv (b + cn)\,(p_{rr})^2\,L + (b + cn)\,(p_{rs} - \tau)^2\,L$$

where we have introduced (3) and (4) in (5). In our model, price competition acts as a dispersion force while the difference in productivity favours the clustering of firms in the high productivity country.

An interior equilibrium exists if and only if $\pi_r = \pi_s$. This leads to the following location equilibrium:

$$\lambda^* = \frac{1}{2} + A(\tau)(f_1 - t_1 - f_2 + t_2 + \theta) \tag{13}$$

where

$$\theta \equiv \phi_2 - \phi_1 > 0 \qquad A(\tau) \equiv \frac{2b + cn}{cnL\tau^2\,(b + cn)} > 0$$

It is straightforward to check that $\partial\lambda^*/\partial\theta > 0$ and $\partial^2\lambda^*/\partial\theta\partial\tau < 0$. In other words, the high productivity country is more and more attractive when trade costs decline. Such a result is similar to one obtained with a home market effect. The attractivity of the country having the highest market size increases with the degree of economic integration (see Ottaviano and Thisse, 2004).

# 4 Endogenous subsidy for firms

The objective of each national government is to maximise (8) with respect to $f_r$ given by

$$\underset{f_r}{\text{Max}} W_r = S_r L + t_r \lambda_r n - f_r \lambda_r n + L$$

where we have introduced (11) in (8), taking as given the decision of the other government. For each country, first-order condition is expressed as follows

$$\frac{dW_r}{df_r} = L\frac{\partial S_r}{\partial \lambda_r}\frac{\partial \lambda_r}{\partial f_r} + t_r n\frac{\partial \lambda_r}{\partial f_r} - \lambda_r n - f_r n\frac{\partial \lambda_r}{\partial f_r} = 0$$

Clearly, each country has incentives to raise subsidies for firms in order to increase, in one hand, the surplus ($dS_r/df_r > 0$) *via* a rise in $\lambda_r$ and, on the other hand, the tax revenue ($t_r n\partial\lambda_r/\partial f_r > 0$) *via* a rise in tax base. Nevertheless, each country has an incentive to diminish subsidies for firms in order to increase subsidies for households ($-\lambda_r n - f_r n\partial\lambda_r/\partial f_r < 0$). At Nash equilibrium, we have

$$f_1^* = t_1 - B\theta + C(\tau) \gtreqless 0 \quad (14)$$
$$f_2^* = t_2 + B\theta + C(\tau) > 0 \quad (15)$$

where

$$B \equiv \frac{(8b+5cn)}{2(12b+7cn)} \in (1/3, 1/2)$$
$$C(\tau) \equiv \frac{\tau(b+cn)L}{2(2b+cn)^2}\left[2a(b+cn) - \tau(b^2+3bcn+c^2n^2)\right] > 0$$

for admissible values of $\tau$.

Some calculations show that we have $f_1^* > f_2^*$ when

$$\theta < \tilde{\theta} \equiv \frac{t_1 - t_2}{2B}$$

Clearly, identifying the country providing the highest level of individual subsidy for firms requires to compare the productivity gap with the relative taxation of firms. We first consider the case where profit tax burden is higher in the country exhibiting a location advantage. This is the more reasonable restriction since empirical evidences reveal that corporate tax rates have always been higher in the most industrialized countries with high productivity as shown by Baldwin and Krugman (2004) for the European Union.[6] Thus, the condition $\theta < \tilde{\theta}$ suggests that a firm located in the high productivity countries receives a higher level of subsidy only if their

[6] From theoretical standpoint, recent economic geography models with tax competition using similar assumptions concerning workers and firms show the tax rate is higher in the country enjoying an advantage (see Gaigne and Riou, 2004 and Ottaviano and Van Ypersele, 2005).

productivity advantage is low enough compared with their tax disadvantage. Intuition behind this result is straightforward. A country combining a weak productivity advantage with high tax pressure has to give a more generous subsidy for firms to sustain its attractiveness. When the productivity wedge becomes high enough, the high productivity country does not need to set higher subsidy for each firm in order to compensate higher corporate tax rate.

Now assume tax harmonisation ($t_1 = t_2$) or a higher profit taxation in the low productivity country. This is mechanically associated with higher subsidy in the low-productivity country. In other words, since tax harmonisation offset pure fiscal incentives of the location choices, the government of the low-productivity country has to increase its subsidy for firms to a higher level than the high-productivity one in order to unless partially compensate its productivity disadvantage.

Finally, whatever the corporate tax rates, it is easy to check that $f_2^* - t_2 > f_1^* - t_1$. In words, the subsidy net of profit tax rate is higher in the low productivity country, regardless of the productivity gap. Some static comparatives show that $\partial(f_1^* - t_1)/\partial\theta < 0$ and $\partial(f_2^* - t_2)/\partial\theta > 0$. In other words, a convergence of the productivity levels implies also a convergence of net-of-tax subsidies for each firm.

To summarise,

**Proposition 1** *The country having the lowest productivity sets higher net of tax subsidies for each firm established in its jurisdiction. The convergence of the productivity levels implies the convergence of the net of tax subsidies.*

Now we can address the relation between trade integration and the equilibrium level of the subsidy allocated to firms. This relation is captured in $C(\tau)$ which we can write as follows:

$$C(\tau) = \Gamma(\tau) + \Upsilon(\tau)$$

with $\Gamma(\tau) = L\tau(b + cN)^2 \left[(2a - \tau b)/2(cN + 2b)^2\right] > 0$ and $\Upsilon(\tau) = -1/(2A(\tau)) < 0$.

Firstly, observe that $C(\tau)$ doesn't depend on the possible asymetric parameters of the economy that is $t_r$ and $\theta$. Thus, we can expect that both subsidies similarly evolve with trade costs. Secondly, $C(\tau)$ includes the two opposite incentives which matter when choosing the level of $f_r$. The first one refers to the positive impact of the subsidy on the consumer surplus ($\Gamma(\tau)$). The second one is related with the cost for immobile households of

a rise in subsidies ($\Upsilon(\tau)$). For a given budget constraint, hosting more firms diminishes the share of public spendings for households. Taking both effects into account gives rise to a bell-shaped relationship between the equilibrium level of subsidy and trade cost. Indeed, we get $\partial f_r^*/\partial\tau = \partial C(\tau)/\partial\tau$ which is positive when $\tau < a(b+cn)/\left(b^2+3cn+c^2n^2\right)$ and negative otherwise. Starting from a low level of trade cost, a first increase in $\tau$ favors a race to the top in subsidies. Since the positive impact of higher agglomeration on the surplus grows with $\tau$ but that the sensitivity of the location choices to variations of $f_r$ decreases with $\tau$ $\left(\partial^2\lambda_r/\partial f_r\partial\tau < 0\right)$, government must promote higher subsidies to attract a given number of firms. This process comes to an end for a given level of trade cost. Beyond this trade cost, it becomes too costly to go on offering higher subsidies in terms of the net benefits from the public policy. Indeed, it is straightforward to check that the level of subsidy which maximizes the net benefits component of the objective function is strictly decreasing in $\tau$. Then the sense of the game in subsidies is reversed and governments are prompted to offer lower subsidies.

However, introducing (14) and (15) in (13) gives

$$\lambda^* = \frac{1}{2} + \theta(1-2B)A(\tau) > \frac{1}{2} \tag{16}$$

so that a majority of firms are located in the high productivity country even though net-of tax subsidies net for firms are higher in the low productivity country. Additionally, competition in grants cannot prevent full agglomeration of the mobile production when the productivity wedge is high enough. Indeed, trivial calculations show that $\lambda^* = 1$ when $\theta \geq \theta_{agglo}$ with

$$\theta_{agglo} \equiv \frac{1}{2(1-2B)A(\tau)} \tag{17}$$

Hence, the productivity wedge threshold beyond which all firms are located in the high-productivity country is decreasing with the degree of economic integration. More generally, a fall in trade barriers favours the location of firms in the high productivity country.

Because $\lambda^* > 1/2$, the most generous country in terms of subsidy per firm is not necessary the country with the highest budget devoted to the total number of firms located in its area. Some calculations show that

$$\begin{aligned}\Delta^f &\equiv f_1^*\lambda^* n - f_2^*(1-\lambda^*)n \\ &= \left[(1-2B)(t_1+t_2+2C(\tau))A(\tau) - B\right]\theta n + \frac{(t_1-t_2)n}{2}\end{aligned}$$

Assume first that tax rates on wages and profits are equal in both countries ($\rho_1 = \rho_2$ and $t_1 = t_2 = t$) and observe that this condition implies $f_2^* > f_1^*$. Thus, the total funds devoted to firms are higher in the high productivity country if the following condition is checked

$$t > \frac{B}{2(1-2B)A(\tau)} - C(\tau) \equiv \overline{t}(\tau) > 0$$

In words, when tax harmonisation prevails on wages and profits, the budget devoted to firms in the high productivity country may be higher even if the individual subsidy is lower. This case emerges when the corporate tax rate is high enough. Indeed, for a given level of agglomeration in the high productivity country and a given subsidies gap, we can observe that the difference of public funds distributed to firms in each country increases with the level of these subsidies. Thus, since $f_r$ is an increasing function of $t$, high level of taxation favours $\Delta^f > 0$. Moreover, when trade integration is well-advanced this constraint on taxation is weakened as the right hand side of the inequality is minimized for low level of trade costs. Intuition behind this result is straighforward : low trade costs favors agglomeration economies in the high-productivity country, and then the number of recipients of the subsidy.

Now, let consider how the gap of public funds devoted to firms influences the gap of budget for households that we can define as $\Delta^h = t\,(2\lambda - 1) - \Delta^f$. Mechanically, since the high productivity country always hosts more firms, tax harmonisation gives rise to lower tax revenues in the low productivity country. This makes impossible a policy which would spend more both for firms and households in this last country. Contrary to this, when the high productivity country allocates more public funds for firms, its government can also allocates more for households. Two conditions favors the emergence of this scenario. First, the corporate tax rate must be high enough to allow $\Delta_f > 0$. Secondly, trade costs must be relatively high to limit the number of firms receiving a subsidy. This allows the government of the high productivity country to sustain a higher level of public spending for households.

Finally, when we consider that the high productivity country sets higher corporate tax rate, the difference between countries in public funds to households does not change while $\Delta^f > 0$ becomes more possible. Hence, our previous results do not change qualitatively but the case where both the budget devoted to firms and households is more important in country 1 is more likely.

Hence, to summarise,

**Proposition 2** *Provided that both trade costs and corporate tax rates are high, the high-productivity country can spend more for firms and households than the low-productivity country. Whatever the level of trade costs and taxation, this last country is unable to have the same spending policy* ($\Delta^{f,h} < 0$).

Finally, to complete the analysis, we can determine the type of agent (workers or firms) who is the net recipient in the redistribution system for each country. Observe that $f_2^* - t_2 > 0$ is always checked. This implies that $h_2^* - \rho_2 < 0$, according to (11). This means that the tax burden for households (resp., firms) is higher (resp., lower) than subsidies in the low-productivity country. On the other hand, we have $f_1^* - t_1 < 0$ when

$$\theta > \frac{C(\tau)}{B} \equiv \widehat{\theta}.$$

Hence, firms located in the high productivity country have a tax rate superior to subsidies, provided that the productivity wedge is high enough or trade costs

take extreme values since $C(\tau)$ described a bell-shaped curve with respect to $\tau$. For instance, if the trade integration process is well advanced, the less vigorous subsidy competition may benefit to households in the high productivity country who can become the net-recipients of the public policy. Whatever the level of trade costs, this cannot occur in the low productivity country where the pressure to attract firms always makes them the net-recipients. This results gives an illustration of how trade integration may place immobile households in different positions depending on their location. To sum up,

**Proposition 3** *Regardless of trade costs, households located in the low productivity country are net-contributors of the subsidies for firms. In contrast, households living in the high productivity country are net-recipients of the public funds provided that its productivity are high enough and/**or** trade costs reach extreme values.*

## 5 On the optimality of subsidies

Another question, fundamental as well, is to determine whether the subsidy competition among countries leads to inefficiently high subsidisation of firms at the expense of the households. From a traditional model of tax competition without coordination, Keen and Marchand (1997) show

that competition for mobile capital leads to over-provision of public inputs. More precisely, starting from the non-cooperative equilibrium, and holding tax rates constant, their analysis reveals that welfare would be improved by a coordinated reduction in the provision of local public inputs and a corresponding increase in the public provision of local public goods benefiting immobile consumer. Such a result emerges because all externalities in the framework developed by Keen and Marchand (1997) imply too high level of public input. In a given country, the capital outflow inducing by a rise in the amount of public input in other countries affects welfare through three routes: (i) capital rent falls (ii) wage rate decreases (iii) tax revenues decline. In our framework, the first two externalities are absents since firm owners are assumed to be located outside the economy and the wage rate does not depend on the location of firms. However, our model exhibits an externality passing through the consumption of private commodities. Recall that the consumer's surplus in each country varies positively with the mass of firms. Consequently, because the difference in subsidies to firms matters for the location choice of their production, an externality passes through the consumers surplus. When deciding its level of subsidies to firms, a country does not internalise the indirect effects on the surplus of consumers located in other countries.

We also have an externality passing through public funds devoted to households. However, this externality is not symmetric. Recall that we have

$$h_1^* L_1 - \rho_1 L_1 = -(f_1^* - t_1)\lambda^* n \quad \text{and} \quad h_2^* L_1 - \rho_2 L_2 = -(f_2^* - t_2)(1-\lambda^*)n.$$

Because $f_2^* - t_2 > 0$, an outflow of firms in the low productivity country leads to higher level of subisidies for households. In contrast, in the high productivity country, a decreasing mass of firms implies a falling amount of public spending for households living in this country, provided that $\theta > \widehat{\theta}$.

To quantify these externalities, we successively focus on the aggregated consumers' surplus and the net benefit of the public policy to households, the sum of these two components being the total welfare, given by

$$W_T \equiv W_1 + W_2 = L(S_1 + S_2) + (t_1 - f_1)\,\lambda^* n + (t_2 - f_2)\,(1-\lambda^*)\,n$$

Let first consider the aggregated consumers' surplus $S_T \equiv L(S_1 + S_2)$. To determine the non-optimality of the decentralised subsidy policies arising from the surplus, we introduce the values of each Nash grant $f_1^*$, $f_2^*$ in

$dS_T/df_r$ and evaluate the sign of the resulting expressions. Some calculations reveal that

$$\left.\frac{dS_T}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*} > 0 \qquad \left.\frac{dS_T}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*} < 0$$

which suggest that a coordinated policy focusing on the consumer surplus alone would reduce the subsidy to firms in the high-productivity country while increasing it in the other country. Intuition behind this result is straightforward and related with the location equilibrium. Indeed, the coordinated policy would induce a lower level of agglomeration suggesting that the location of production at the decentralised equilibrium is too agglomerated. When deciding its level of grants, each country do not internalize that it affects the consumer surplus of the other country. Consequently, more dispersion of mobile firms is needed to maximize the global consumers' surplus.

Now consider the externalities arising from the supply of subsidies devoted to households. Set $H$ the total net revenues received by households where

$$H \equiv \lambda^* n\left(t_1 - f_1\right) + \left(1 - \lambda^*\right) n\left(t_2 - f_2\right).$$

It is straighforward to check that

$$sign\left\{\left.\frac{dH}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*}\right\} = sign\ \left\{-1 + 2\theta(4B-1)A(\tau)\right\} \gtrless 0 \text{ when } \theta \gtrless \ddot{\theta}$$

and

$$sign\left\{\left.\frac{dH}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*}\right\} = sign\ \left\{-1 - 2\theta(4B-1)A(\tau)\right\} < 0$$

with $\ddot{\theta} \equiv \dfrac{(12b+7cn)\,cnL\tau^2\,(b+cn)}{2\,(4b+3cn)\,(2b+cn)} < \theta_{agglo}$.

Clearly, focusing on the consumer surplus or the direct net benefit of the public policy for households may lead to divergent coordinated policies. While $f_2$ may be excessive when we only observe the net benefit of households, it may be considered as too low from the consumer surplus point of view. Similarly, $f_1$ can reach too high values for the aggregate consumer surplus while the externality may work in an opposite direction concerning

the direct effect of subsidy for households. On this last point, it is worth to note the significant influence of trade costs. For low enough trade costs such that $\theta > \ddot{\theta}$, the coordinated policy will improve the total level of grant for households by advocating more subsidies to firms in country 1 and the opposite for country 2. Such a policy consists in promoting higher agglomeration of the tax base in the high productivity country by expecting that the lower level of subsidy to households in country 1 and the loss in tax base in country 2 will be more than compensated by the increasing tax base in country 1 and by the decreasing net contribution to the public policy by households living in country 2. This effect will be stronger, the higher the tax base elasticity to $f_r$ will be. Since this elasticity decreases with $\tau$, low trade costs could imply a coordinated policy in favour of firms located in the high productivity country in order to raise the total net benefits for workers.

Let now evaluate which externality is dominant. To identify this, we introduce the values of each Nash subsidies resulting from non-cooperative policies in $dW_T/df_r$. For the low productivity country we have

$$\left.\frac{dW_T}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*} < 0$$

while we obtain

$$\left.\frac{dW_T}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*} \leq 0 \text{ for all } \theta \text{ such that } \lambda \leq 1$$

for the other country. Hence like Keen and Marchand (1997), our framework displays a compositional inefficiency in the public policy which may be solved by an increase in the public spendings devoted to immobile consumers in both countries. To sum up

**Proposition 4** *The share of public spending for firms is too high in each country.*

Our previous analysis raises the question whether the pattern of public spending is efficient from the social optimum point of view. We have shown that immobile residents enjoy a gain from a coordinated policy. It is straightforward to see that the resulting decrease in the subsidies to firms is Pareto-improving for each country. Indeed, it will be the case if, around the Nash subsidies for firms, the following inequalities are checked:

$$\left\{\begin{array}{l} dW_1 = \frac{\partial W_1}{\partial f_1} df_1 + \frac{\partial W_1}{\partial f_2} df_2 > 0 \\ dW_2 = \frac{\partial W_2}{\partial f_1} df_1 + \frac{\partial W_2}{\partial f_2} df_2 > 0 \end{array}\right. \tag{18}$$

Recalling that $dW_r/df_r = 0$ at the Nash equilibrium and $df_{r,s} < 0$, these inequalities are checked when $dW_r/df_s < 0$ which is a corollary of the social optimum analysis since

$$\left.\frac{dW^T}{df_r}\right|_{f_1=f_1^*;f_2=f_2^*} = \left.\frac{dW_s}{df_r}\right|_{f_1=f_1^*;f_2=f_2^*} < 0$$

Nevertheless, decomposing $dW_s/df_r$ allows to go further in the identification of the two externalities that each government generates for the other one. Indeed, we have

$$\begin{cases} \left.\frac{dW_1}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*} = \underbrace{L\left.\frac{dS_1}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*}}_{-} + \underbrace{\left.\frac{dH_1}{df_2}\right|_{f_1=f_1^*;f_2=f_2^*}}_{+ \text{ if } \theta<\hat{\theta}} < 0 \\ \left.\frac{dW_2}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*} = \underbrace{L\left.\frac{dS_2}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*}}_{-} + \underbrace{\left.\frac{dH_2}{df_1}\right|_{f_1=f_1^*;f_2=f_2^*}}_{+} < 0 \end{cases}$$

Considering first the externality acting through the consumer surplus, the effect is unambigously negative because of the tax base erosion effect induced by an increase of the other country's subsidy to firm. Now consider the externality arising from the direct net benefit of the subsidy policy. Since households of the low productivity country are always the net contributors to the public system, an erosion of their tax base may be advantageous for them. Thus, by increasing its level of subsidy and its attractiveness, the high productivity country generates a positive externality. The same mechanism with the same causes may occur in the last country as long as the households living there are the net-contributors of the public policy that is, provided that the productivity advantage is low enough and/or trade costs are relatively high. Otherwise, beyond $\hat{\theta}$, this externality acts in the opposite direction. Households living in the most productive country becomes net-recipients and suffer from a higher attractiveness of the other country. In other words, the direction of this externality perceived by the high-productivity country depends on the ability of its government to make firms the net-contributors of the public policy. Finally, despite the ambiguous sense of the externality arising from the sign of $dH_r/df_s$, an unilateral increase in subsidy for firms generates an overall negative externality. Indeed, the outflow of tax base is too harmful for consumer's surplus to be counteracted by the potential positive effect arising from the direct net benefits for households.

# 6 Conclusion

With economic integration and international tax coordination agreements, the level of public funds allocated to companies becomes a key element in the location of mobile production. Hence, national governments have a stronger incentive to compete in subsidy to attract firms. As a result, such a non cooperative behavior could induce a rise in public funds for firms at the expense of households.

In this paper we have considered asymmetric competition in subsidies for firms when tax revenues are devoted to both residents and mobile firms. Interestingly, we have shown that promoting tax harmonisation leads the country having the lowest productivity to set higher subsidies for firms. Indeed, the high productivity country will be the most generous for firms only when it suffers from a tax disadvantage and only benefits from a weak productivity advantage. Moreover, trade integration has very different effects on the role of immobile households in the public sector of each country. While households located in the low-productivity country seem to be the net-contributors of their public sector regardless of trade costs, residents of the other country can shift from a position of net-contributor to net-recipient -for a given productivity advantage- when trade costs are low enough.

Finally, we identify two main externalities which make the Nash equilibrium in subsidies an inefficient equilibrium. Even if these two externalities may act in opposite directions, we show that a coordinated policy promoting an increase of the public spendings devoted to households in both countries will be beneficial, as suggested by Keen and Marchand (1997). Despite a different framework our results are convergent. Clearly, assuming foreign direct investments and abstracting from externalities arising from capital rent, our model also suggests that governments could spend too much for firms. The robustness of this result should recall that tax harmonisation which is frequently debated by policy makers only focuses on a particular aspect of a more global problem relative to the inefficiencies that emerge when countries compete for firms.

# References

Baldwin R. E. and P. Krugman (2004). Agglomeration, integration and tax harmonisation. *European Economic Review* 48(1), 1-23.

Benassy-Quéré A., N. Gobalraja, and A. Trannoy (2005). Tax competition and public input. CEPII working paper n°2005-08.

Blomström M. and A. Kokko (1998). Multinational corporations and spillovers. *Journal of economic surveys* 12(3), 247-77.

Borck R. (2004). Fiscal competition, capital-skill complementarity and the composition of public spending. DIW Berlin Working Paper 504.

Combes P.P. and JH. Overman (2005). The Spatial Distribution of Economic Activities in the European Union. Handbook of Urban and Regional Economics, Elsevier-North Holland, Amsterdam.

Gaigné C. and S. Riou (2004). Globalisation, tax competition and fiscal equalization. University of Strathclyde Working Paper.

Head C.K., J. Ries and D. Swenson (1999). Attracting foreign manufacturing: investment promotion and agglomeration. *Regional Science and Urban Economics* 29, 197-218.

Kind H., K. Midelfart Knarvik and G. Schjelderup (2000). Competing for capital in a 'lumpy' world. *Journal of Public Economics* 78, 253-274.

Keen M. and M. Marchand (1997). Fiscal Competition and the Pattern of Public Spending. *Journal of Public Economics* 66, 33-53.

Krogstrup S., (2003). Are capital taxes racing to the bottom in the European Union ? HEI working paper, n°01/2003.

Keen M., Marchand M., 1997. Fiscal competition and the pattern of public spending. *Journal of Public Economics*, 66, 33-53.

Ludema R. and I. Wooton (2000). Economic geography and the fiscal effects of regional integration *Journal of International Economics* 52, 331-357.

Matsumoto M. (2000). A note on the composition of public expenditure under capital tax competition. *International Tax and Public Finance* 7, 691-697.

Matsumoto M. (2004). The mix of public inputs under tax competition. *Journal of Urban Economics* 56(2), 389-396

Ottaviano G., T. Tabuchi and J.-F. Thisse (2002). Agglomeration and trade revisited. *International Economic Review* 43, 409-436.

Ottaviano G. and T. Van Ypersele (2005). Market access and tax competition. *Journal of International Economics* 67, 25-46.

Rodrik D. (1998). Why Do More Open Economies Have Bigger Governments? *Journal of Political Economy* 106(5), 997-1032.

Sanz I. and F. Velasquez (2004). The evolution and convergence of the government expenditure composition in the OECD countries. *Public Choice* 119, 61-72.

Wilson J. and D. Wildasin (2003). Tax competition: bane or boon? *Journal of Public Economics* 88, 1065-1091.